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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : B29C 45/16

A1

(11) International Publication Number: WO 91/02640

(43) International Publication Date: 7 March 1991 (07.03.91)

(21) International Application Number: PCT/US90/04566

(22) International Filing Date: 13 August 1990 (13.08.90)

(30) Priority data:

394,228	14 August 1989 (14.08.89)	US
539,855	18 June 1990 (18.06.90)	US

(60) Parent Application or Grant
(63) Related by Continuation
US 539,855 (CIP)
Filed on 18 June 1990 (18.06.90)

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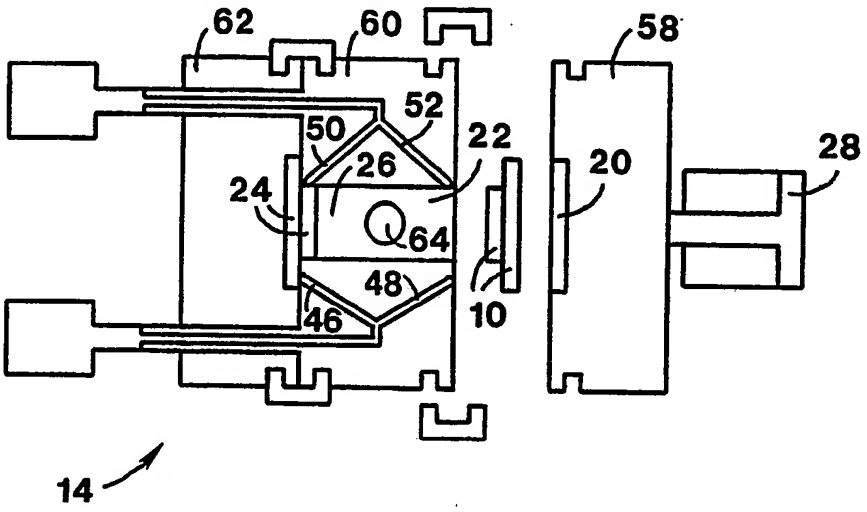
(81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent)*, DK (European patent), ES (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: SEQUENTIALLY INJECTED MULTI-COMPONENT INJECTION MOLDING



(57) Abstract

A highly efficient and highly controllable method and an apparatus for core-back injection molding of multi-component plastic products. Core-back injection molding makes possible the injection of a first plastic material into a mold cavity followed by retracting a barrier means (22, 26) in order to enable injection of a second plastic material without separating any mold halves. The present invention enables very efficient injection molding because both injection units may be operated at the same time, and the present invention enables very controlled injection because it is possible to inject only one half of the cavities by a specific injection unit at the same time, or even only one quarter of the cavities by a specific injection unit at the same time. The injection molding apparatus includes a first injection unit, a second injection unit, a right adjustable mold cavity (20) with a first moveable barring means (22), a left adjustable mold cavity (24) with a second moveable barring means (26), and a common standard clamping unit (28).

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SEQUENTIALLY INJECTED MULTI-COMPONENT INJECTION MOLDING

BACKGROUND OF THE INVENTION

The present invention generally pertains to a method and an apparatus for multi-cavity injection molding of plastic products and is particularly directed to a highly efficient and highly controllable method and an apparatus for core-back and shuttle stack injection molding of multi-component plastic products. Core-back injection molding makes possible the injection of a first plastic material into a mold cavity, followed by retracting a barrier means, in order to enable injection of a second plastic material without separating any mold halves.

Heretofore core-back multi-cavity injection molding of multi-component plastic products was carried out by simultaneous injection of all cavities by a first plastic material and subsequently in time by simultaneous injection of all cavities by a second plastic material.

Examples of prior art core-back injection molding may be seen in the following U. S. patents: 4,157,883 to Mares: 4,508,676 to Sorensen; 4,726,758 to Sekine et al. and 4,840,760 to Oishi.

The problem with such injection molding is that it is very inefficient because only one injection unit is operating at the time, and it is not very controlled because all the cavities are filled at the same time, causing slow injection speeds and balancing problems in filling the individual cavities evenly.

The present invention enables very efficient injection molding because both injection units may be operated at the time, and the present invention enables very controlled injection because it is possible to inject only one half of the cavities by a specific injection unit at the same time, or even only one quarter of the cavities by a specific injection unit at the same time.

Heretofore shuttle stack injection molding of multi-component plastic products was either carried out so that only two products were produced in each injection molding cycle, with the resulting low efficiency, or alternatively so that at least two mold cavities were filled at the same time by the same injection unit, giving rise to unbalanced filling of the cavities.

The present invention enables production of four or more products in each production cycle while the filling of each cavity may be separate and therefore may be fully controlled.

SUMMARY OF THE INVENTION

A first aspect of the present invention provides a method of cyclic injection molding a first multi-component plastic product and a second multi-component plastic product in an injection molding apparatus comprising a first injection unit, a second injection unit, a right adjustable mold cavity with a first moveable barring means, a left adjustable mold cavity with a second moveable barring means, and a clamping unit, the method comprising the steps of:

(a) protracting the first barring means;

(b) retracting the second barring means;

(c) shutting the clamping unit to thereby apply clamping force simultaneously on the right and left adjustable mold cavity;

(d) injecting a first portion of a first plastic material by the first injection unit into the right adjustable mold cavity, which has its first barring means in the protracted condition, to form a first component of the first multi-component product;

(e) injecting a first portion of a second plastic material by the second injection unit into the left adjustable mold cavity which has its second barring means in the retracted position, to form a second component of the second multi-

component product while the left adjustable mold cavity encases a first component of the second multi-component product which has been injected into the left adjustable mold cavity in the previous cycle, whereby the first component of the second multi-component product combines with said injected first portion of the second plastic material to thereby cast said second multi-component product;

(f) opening the clamping unit in order to open the left adjustable mold cavity;

(g) ejecting the second multi-component product;

(h) protracting the second barring means;

(i) retracting the first barring means;

(j) shutting the clamping unit to thereby apply clamping force simultaneously on the right and left adjustable mold cavity;

(k) injecting a second portion of the first plastic material material by the first injection unit into the left adjustable mold cavity, which has its second barring means in the protracted position, to form a first component of the second multi-component product and to encase the first component of the second multi-component product in the left mold cavity for employment in step (e) of the succeeding cycle;

(l) injecting a second portion of the second plastic material by the second injection unit into the right adjustable mold cavity which has its first barring means in the retracted position, to form a second component of said first multi-component product while the right adjustable mold cavity encases the first component of the first multi-component product which has been injected into the right adjustable mold cavity in step (e), whereby the first component of the first multi-component product combines with said injected second portion of the second plastic material to thereby cast said first multi-component product;

(m) opening the clamping unit in order to open the right adjustable mold cavity;

(n) ejecting the first multi-component product.

A second aspect of the present invention provides a method of cyclic injection molding a first multi-component plastic product and a second multi-component plastic product in an injection molding apparatus comprising a first injection unit, a second injection unit, a common clamping unit, right, center and left molding blocks for defining a right adjustable mold cavity between the right and center molding blocks and a left adjustable mold cavity between the center and left molding blocks, a first left runner system for leading plastic molding material from the first injection unit to the left adjustable mold cavity, a first right runner system for leading plastic molding material from the first injection unit to the right adjustable mold cavity, a second left runner system for leading plastic molding material from the second injection unit to the left adjustable mold cavity, a second right runner system for leading plastic molding material from the second injection on unit to the right adjustable mold cavity, the method comprising the steps of:

(a) adjusting the right mold cavity;

(b) adjusting the left mold cavity;

(c) shutting the common clamping unit to thereby apply clamping force with the common clamping unit on the right and left adjustable mold cavity;

(d) injecting a first portion of a first plastic material by the first injection unit into the right adjustable mold cavity, via the first right runner system, to form a first component of the first multi-component product;

(e) injecting a first portion of a second plastic material by the second injection unit into the left adjustable mold cavity, via the second left runner system, to form a second component of said second multi-component product while the

left adjustable mold cavity encases a first component of the second multi-component product which has been injected into the left adjustable mold cavity in the previous cycle, whereby the first component of the second multi-component product combines with said injected first portion of the second plastic material to thereby cast said second multi-component product;

(f) opening the common clamping unit in order to open the left adjustable mold cavity;

(g) ejecting the second multi-component product;

(h) adjusting the left mold cavity;

(i) adjusting the right mold cavity;

(j) shutting the common clamping unit to thereby apply clamping force with the common clamping unit on the left and right adjustable mold cavity;

(k) injecting a second portion of the first plastic material by the first injection unit into the left adjustable mold cavity, via the first left runner system, to form a first component of the second multi-component product and to encase the first component of the second multi-component product in the left mold cavity for employment in step (e) of the succeeding cycle;

(l) injecting a second portion of the second plastic material by the second injection unit into the right adjustable mold cavity, via the second right runner system, to form a second component of said first multi-component product while the right adjustable mold cavity encases the first component of the first multi-component product which has been injected into the right adjustable mold cavity in step (e), whereby the first component of the first multi-component product combines with said injected second portion of the second plastic material to thereby cast said first multi-component product;

(m) opening the common clamping unit in order to open the right adjustable mold cavity;

(n) ejecting the first multi-component product.

A third aspect of the present invention provides an apparatus for cyclic injection molding a first multi-component plastic product and a second multi-component plastic product comprising a first injection unit, a second injection unit, a right adjustable mold cavity with a first moveable barring means, a left adjustable mold cavity with a second moveable barring means, and

means for protracting the first barring means;

means for retracting the second barring means;

means for shutting the clamping unit to thereby apply clamping force simultaneously on the right and left adjustable mold cavity;

means for injecting a first portion of a first plastic material by the first injection unit into the right adjustable mold cavity, when the right adjustable mold cavity has its first barring means in the protracted condition;

means for injecting a first portion of a second plastic material by the second injection unit into the left adjustable mold cavity when the second injection unit has its second barring means in the retracted position;

means for opening the clamping unit in order to open the left adjustable mold cavity;

means for ejecting the second multi-component product;

means for protracting the second barring means;

means for retracting the first barring means;

means for shutting the clamping unit to apply clamping force simultaneously on the right and left adjustable mold cavity;

means for injecting a second portion of the first plastic material by the first injection unit into the left adjustable mold cavity, when the first injection unit has its second barring means in the protracted position;

means for injecting a second portion of the second plastic material by the second injection unit into the right adjustable mold cavity when the right adjustable mold cavity has as its first barring means in the retracted position;

means for opening the clamping unit in order to open the right adjustable mold cavity;

means for ejecting the first multi-component product.

A fourth aspect of the present invention provides an apparatus for cyclic injection molding a first multi-component plastic product and a second multi-component plastic product comprising a first injection unit, a second injection unit, a common clamping unit, right, center and left molding blocks for defining a right adjustable mold cavity between the right and center molding blocks and a left adjustable mold cavity between the center and left molding blocks, the center block comprising a first left runner system for leading plastic molding material from the first injection unit to the left adjustable mold cavity, a first right runner system for leading plastic molding material from the first injection unit to the right adjustable mold cavity, a second left runner system for leading plastic molding material from the second injection unit to the left adjustable mold cavity, a second right runner system for leading plastic molding material from the second injection unit to the right adjustable mold cavity, and

means for adjusting the right mold cavity;

means for adjusting the left mold cavity;

means for shutting the common clamping unit in order to apply clamping force with the common clamping unit on the right and left adjustable mold cavity;

means for injecting a first portion of a first plastic material by the first injection unit into the right adjustable mold cavity, via the first right runner system;

means for injecting a first portion of a second plastic material by the second injection unit into the left adjustable mold cavity, via the second left runner system;

means for opening the common clamping unit in order to open the left adjustable mold cavity;

means for ejecting the second multi-component product;

means for readjusting the left mold cavity;

means for readjusting the right mold cavity;

means for shutting the common clamping unit in order to apply clamping force with the common clamping unit on the left and right adjustable mold cavity;

means for injecting a second portion of the first plastic material by the first injection unit into the left adjustable mold cavity, via the first left runner system;

means for injecting a second portion of the second plastic material by the second injection unit into the right adjustable mold cavity, via the second right runner system;

means for opening the common clamping unit in order to open the right adjustable mold cavity;

means for ejecting the first multi-component product.

In each of the four above mentioned aspects of the invention there may be only one injection unit, whereby the first injection unit and the second injection unit is the same injection unit.

A fifth aspect of the present invention provides a method of cyclic injection molding a multicomponent product in an injection molding system comprising a mold positioning system, a first injection system and a second injection system, and a left molding block, a right molding block and an intermediate molding block located between the left and the right molding blocks, said blocks being disposed for axial movement in respect to each other,

the left molding block defining a first left general mold cavity part and the intermediate molding block defining a first left gated mold cavity part and a second left gated mold cavity part,

the right molding block defining a first right general mold cavity part and the intermediate molding block defining a first right gated mold cavity part and a second right gated mold cavity part,

the intermediate molding block defining a first runner system and a second runner system connected to said gated mold parts, the method comprising the steps of:

(a) combining by the mold positioning system said molding blocks so that the first left general mold cavity part is connected with the first left gated mold cavity part to form a first left mold cavity,

(b) injecting by the first injection system via the first runner system a first fluid plastic material into the first left mold cavity, and solidifying the material to produce a first left plastic component,

(c) separating by the mold positioning system the right and center molding blocks,

(d) combining by the mold positioning system said molding blocks so that the first right general mold cavity part is connected with the first right gated mold cavity part to form a first right mold cavity,

(e) injecting by the first injection system via the first runner system first fluid plastic material into the first right mold cavity, and solidifying the material to produce a first right plastic component,

(f) separating by the mold positioning system the left and center molding blocks, retaining the first left plastic component on the first left general mold cavity part,

(g) combining by the mold positioning system said molding blocks so that the first left general mold cavity part is connected with the second left gated mold cavity part to form a second left mold cavity, which encompasses said first left plastic component,

(h) injecting by the second injection system via the second runner system a second fluid plastic material into the second left mold cavity so that the second fluid plastic is united with the first left plastic component and solidifying the material to mold a first left multicomponent plastic product,

(i) separating by the mold positioning system the right and center molding blocks, retaining the first right plastic component on the first right general mold cavity part,

(j) combining by the mold positioning system said molding blocks so that the first right general mold cavity part is connected with the second right gated mold cavity part to form a second right mold cavity, which encompasses said first right plastic component,

(k) injecting by the second injection system via the second runner system second fluid plastic material into the second right mold cavity so that the second fluid plastic is united with the first right plastic component and solidifying the material to mold a first right multicomponent plastic product,

(l) separating by the mold positioning system the left and center molding blocks, to eject the first left product molded in step (h),

wherein step (c) comprises the step of

(m) ejecting a first right product molded in step (k) of the preceding molding cycle.

Another aspect of the present invention provides a method wherein additionally the left molding block defines at least one second left general mold cavity part and the right molding block defines at least one second right general mold cavity part, and additionally comprising the steps of:

wherein step (g) comprises the step of

(n) combining by the mold positioning system said molding blocks so that a second left general mold cavity part is connected with the first left gated mold cavity part to form a third left mold cavity,

wherein step (h) comprises the step of

(o) injecting by the first injection system via the first runner system first fluid plastic material into the third left mold cavity, and solidifying the material to produce a second left plastic component,

wherein step (i) comprises the step of

(p) separating by the mold positions system the right and center molding blocks,

wherein step (j) comprises the step of

(q) combining by the mold positioning system said molding blocks so that a second right general mold cavity part is connected with the first right gated mold cavity part to form a third right mold cavity,

wherein step (k) comprises the step of

(r) injecting by the first injection system via the first runner system first fluid plastic material into said third right mold cavity, and solidifying the material to produce a second right plastic component,

wherein step (l) comprises the step of

(s) separating by the mold positioning system the left and center molding blocks, retaining the second left plastic component on said second left general mold cavity part,

wherein step (a) of the following cycle comprises the step of

(t) combining by the mold positioning system said molding blocks so that a specific second left general mold cavity part is connected with the second left gated mold cavity part to form a fourth left mold cavity, which encompasses said second left plastic component,

wherein step (b) of the following cycle comprises the step of

(u) injecting by the second injection system via the second runner system second fluid plastic material into the fourth left mold cavity so that the second fluid plastic is united with the second left plastic component and solidifying the material to mold a second left multicomponent plastic product,

wherein step (c) of the following cycle comprises the step of

(v) separating by the mold positioning system the right and center molding blocks, retaining the second right plastic component on said specific second right general mold cavity part,

wherein step (d) of the following cycle comprises the step of

(w) combining by the mold positioning system said molding blocks so that said specific second right general mold cavity part is connected with the second right gated mold cavity part to form a fourth right mold cavity, which encompasses said second right plastic component,

wherein step (e) of the following cycle comprises the step of

(x) injecting by the second injection system via the second runner system second fluid plastic material into the fourth right ;mold cavity so that the second fluid plastic is united with the second right plastic component and solidifying the material to mold a second right multicomponent plastic product,

wherein step (f) of the following cycle comprises the step of

(y) separating by the mold positioning system the left and center molding blocks, to eject the second left product molded in step (u),

wherein step (p) comprises the step of

(z) ejecting a second right product molded in step (e).

Additional features of the present invention are described in relation to the description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWING

Figures 1 through 4 show within a molding cycle four chronological top sectional views of an injection molding apparatus according to the invention used to operate the method of the invention.

Figures 5 through 12 show within a cycle four chronological top sectional views of an injection molding system used for operating the cyclical method of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figures 1 through 4. Shown is a first preferred embodiment of the invention depicting an apparatus 14 for cyclic injection molding a first multi-component plastic product 10 and a second multi-component plastic product 12 comprising a first injection unit 16, a second injection unit 18, a right adjustable mold cavity 20 with a first moveable barring means 22, a left adjustable mold cavity 24 with a second moveable barring means 26, and a hydraulic piston 64 for

protracting and retracting the first and second barring means 22, 26, a common clamping unit 28 to apply clamping force simultaneously on the right and left adjustable mold cavity 20, 24, and for opening and closing the right and left adjustable mold cavity 20, 24, right, center and left molding blocks 58, 60, 62 respectively for defining the right adjustable mold cavity 20, between the right and center molding blocks 58, 60 and the left adjustable mold cavity 24, between the center and left molding blocks 60, 62, right locking means 54 for locking the right molding block 58 to the center molding block 60, left locking means 56 for locking the center molding block 60 to the left molding block 62, a first left runner system 46 for leading plastic molding material from the first injection unit 16 to the left adjustable mold cavity 24, a first right runner system 48 for leading plastic molding material from the first injection unit 16 to the right adjustable mold cavity 20, a second left runner system 50 for leading plastic molding material from the second injection unit 18 to the left adjustable mold cavity 24, and a second right runner system 52 for leading plastic molding material from the second injection unit 18 to the right adjustable mold cavity 20.

Referring again to Figures 1 through 4. The operation of the first preferred embodiment is as follows:

The first moveable barrier means 22 is protracted by the hydraulic piston 64 and the second moveable barrier means 26 is retracted simultaneously by the same hydraulic piston 64 thereby adjusting the right and the left mold cavity 20, 24. In other embodiments of the invention it is possible to use separate protracting and retracting means to move the different barrier means independently and at different times.

Then the clamping unit 28 is shut by moving relatively the right and left molding blocks 58, 62 together, in order to apply clamping force simultaneously on the right and left adjustable mold cavity 20, 24. The right and center molding blocks 58, 60, are locked together by the right locking means 54. A first portion of

a first plastic material 30 is injected by the first injection unit 16 into the right adjustable mold cavity 20, which has its first barring means 22 in the protracted condition, to form a first component of the first multi-component product 32. Simultaneously a first portion of a second plastic material 42 is injected by the second injection unit 18 into the left adjustable mold cavity 24 which has its second barring means 26 in the retracted position, to form a second component of the second multi-component product 36 while the left adjustable mold cavity 24 encases a first component of the second multi-component product 40 which has been injected into the left adjustable mold cavity 24 in the previous cycle, whereby the first component of the second multi-component product 40 combines with said injected first portion of the second plastic material 34 to thereby cast said second multi-component product 12.

The center and left molding blocks 60, 62 are unlocked by the left locking means 56 and the clamping unit 28 is then activated in order to open the left adjustable mold cavity 24, by moving relatively the right and left molding blocks 58, 62 apart, so that the second multi-component product 12 may be ejected.

Hereafter the second moveable barrier means 26 is protracted by the hydraulic piston 64 and the first moveable barrier means 22 is retracted simultaneously by the same hydraulic piston 64 thereby adjusting the right and the left mold cavity 20, 24.

It is an important advantage of the present invention that when the left or right mold cavity is opened the clamping unit is not providing any clamping force on the mold, so that the barrier means may be moved freely without any increased friction which normally occurs whenever clamping force is applied to the mold cavities.

Then the clamping unit 28 is shut by moving relatively the right and left molding blocks 58, 62 together, in order to apply clamping force simultaneously on

the right and left adjustable mold cavity 20, 24. The center and left molding blocks 60, 62 are locked together by the left locking means 56. A second portion of a first plastic material 38 is injected by the first injection unit 16 into the left adjustable mold cavity 24, which has its second barring means 26 in the protracted condition, to form a first component of the second multi-component product 36 to thereby encase the first component of the second multi-component product 40 in the left mold cavity 24 for employment in the succeeding cycle. Simultaneously a second portion of a second plastic material 42 is injected by the second injection unit 18 into the right adjustable mold cavity 20 which has its first barring means 22 in the retracted position, to form a second component of the first multi-component product 44 while the right adjustable mold cavity 20 encases a first component of the first multi-component product 32 which has been injected into the right adjustable mold cavity 20 previously, whereby the first component of the first multi-component product 32 combines with said injected second portion of the second plastic material 42 to thereby cast said first multi-component product 10.

The right and center molding blocks 58, 60 are unlocked by the right locking means 54 and the clamping unit 28 is then activated in order to open the right adjustable mold cavity 20 my moving relatively the right and left molding blocks 58, 62 apart, so that the first multi-component product 10 may be ejected. The first multi-component product 10 is identical to the second multi-component product 12, but in other embodiments of the invention it is possible to mold different products in the right mold cavity 20 and the left mold cavity 24, for example a container and a lid of a multi-walled product with an oxygen barrier in one of the walls, or an A side and a B side of an audio cassette, or a front bumper and a rear bumper for an automobile.

While the above description contains many specificities, these should not be construed as limitations on the scope of the invention, but rather as an ex-

emplification of the preferred embodiment thereof. Many other variations of the invention are possible.

For example is it not necessary that the first mold cavity and the second mold cavity are in a stacked configuration as shown in the illustrated preferred embodiment. In a second preferred embodiment of the present invention the first and second mold cavities may for example be placed side by side, the first and second mold cavity alternately opening every half molding cycle as described in the summary of the invention. For a description of a suitable locking means reference is made to for example US Patent 4,005,964 to Bishop.

Of particular interest is a third preferred embodiment of the present invention which has a first and a second mold cavity in a side by side configuration, operating like the second preferred embodiment; and a third and fourth mold cavity also in a side by side configuration and operating like the second embodiment. The first and second mold cavity being on a left side in a stacked configuration in relation to the third and fourth mold cavity being on a right side. The left side opening one quarter cycle displaced in time in relation to the right side. Fir a description of a suitable cycle reference is made to for example US patents 4,400,341 and 4,464,327 both to Sorensen.

In this third preferred embodiment both injection units inject every quarter cycle, each into a different mold cavity, and one different mold cavity opens to eject a multi-component product every quarter cycle.

In the above description, and the description following hereafter, whenever a specific mold cavity is mentioned like for example the left mold cavity or the third mold cavity, it is possible to place a number of individual mold cavities in place of such mentioned mold cavity, so that an apparatus with a very large number of mold cavities are possible within the limitations of the invention.

A fourth preferred embodiment of the present invention has a first and a second mold cavity in a stacked configuration, operating like the first preferred embodiment; and a third and fourth mold cavity also in a stacked configuration and operating like the first embodiment. The first and second mold cavity being on a left side in a stacked configuration in relation to the third and fourth mold cavity being on a right side, in this way all the four cavities are stacked on each other. The left stacked side opening one quarter cycle displaced in time in relation to the right stacked side.

In this fourth preferred embodiment both injection units inject every quarter cycle, each into a different mold cavity, and one different mold cavity opens to eject a multi-component product every quarter cycle.

In certain cases it may be advantageous to operate the apparatus herein described in a synchronous manner in relation to injection and opening of the mold cavities, but then other advantages such as molding efficiency and injection control may be lost.

The runner systems leading from the injection units to the mold cavities may be direct whereby the injection unit moves from runner orifice to runner orifice whenever a particular cavity needs to be filled or such runner systems may be bifurcated of multi-branched whereby movement of the injection unit may be reduced or eliminated.

There may be valves in the runner systems for leading plastic material to specific mold cavities and blocking access to other mold cavities. Valves may also be used to create hold pressure and when depressurizing a particular runner system or section of such runner system.

No valves have been shown in the illustrated first preferred embodiment. This is because when the first plastic is injected the moveable barring means obstruct flow into one of the mold cavities and when the second plastic is injected the firstly injected plastic obstructs flow into the other mold cavity.

Mold cavities is a stacked configuration as referred to in the present specification may be either in a stack mold, sandwich mold configuration or in a multi-patten machine configuration . A very important feature of the present invention is that it can be carried out using standard injection molding machines with a standard clamping unit. There may be any number of injection units with different colors and/or plastic materials. These injection units do not need to be aligned axially as in the first preferred embodiment, but may be aligned in any direction . The invention is very suitable for the injection molding of four color rear lights for automobiles, in which case four injection units are necessary.

In case of four colors there needs to be four runner systems leading to each cavity. In order to fill only a part of an adjustable mold cavity, the part of the cavity to be filled by plastic material of a particular color may be confined by rotating or moveable barrier means, earlier injected hardened plastic and/or exchangeable mold sections which are rotated or shuttled into their temporary positions.

In order to start up the cycles of the present invention, one way is to place or leave components from a previous cycle in the respective mold cavities. Another way is to inject a larger quantity of plastic material into the mold cavities which have missing plastic components in the first cycle.

It is also possible to operate the apparatus of the first embodiment of the invention in a synchronous manner. In such case the first and second barrier means may be protracted or retracted simultaneously and the right and left mold cavities may be shut or opened synchronously. The apparatus is then operated as follows. The first and second barrier means are protracted, then the first and second portions of the first plastic are injected simultaneously, then the first and second barrier means are retracted simultaneously, and then the first and second portions of the second material are injected simultaneously.

Referring to Figures 5 through 12 showing an injection molding system being a standard injection molding machine with two independent standard injection units 101, 102. The injection molding system comprises a mold positioning system 3 being a standard clamping unit and a left and a right locking means 117, 118 for locking the left molding block 4 together with the intermediate molding block 105 or for locking the right molding block 106 together with the intermediate molding block 105 respectively. A left molding block 104, a right molding block 106, and an intermediate molding block 105, located between the left and the right molding blocks 104, 106 are disposed for axial movement in respect to each other.

The left molding block 104 defines a first left general mold cavity part 107, a second left general mold cavity part 115 and the intermediate molding block 105 defines a first left gated mold cavity part 108 and a second left gated mold cavity part 109.

The right molding block 6 defines a first right general mold cavity part 110, a second right general mold cavity part 116 and the intermediate molding block defines a first right gated mold cavity part 111 and a second right gated mold cavity part 112.

The intermediate molding block 105 defines a first runner system 113 connected to the first left gated mold cavity part and the first right gated mold cavity part 108, 111 and further defines a second runner system 114 connected to the second left gated mold cavity part and the second right gated mold cavity part 109, 112.

The method comprises the following steps:

Figure 5. Combining by the mold positioning system 103 the molding blocks 104, 105, 106 so that the first left general mold cavity part 107 is connected with the first left gated mold cavity part 8 to form a first left mold cavity 119 and so that the second left general mold cavity part 115 is connected with the second

left gated mold cavity part 109 to form a fourth left mold cavity 120, which encompasses a left plastic component 121 formed in the previous production cycle.

Injecting by the first injection system 101 via the first runner system 113 a first fluid plastic material into the first left mold cavity 119, and solidifying the material to produce a first left plastic component 122 and approximately at the same time injecting by the second injection system 102 via the second runner system 114 a second fluid plastic material into the fourth left mold cavity 20, so that the second fluid plastic is united with the second left plastic component 121, and solidifying the material to mold a second left multicomponent plastic product 123.

Figure 6. While locking together the left and intermediate molding blocks 104, 105 and by the left locking means 117, separating by the mold positioning system 103 the right and intermediate molding blocks 106, 105 and retaining a second right plastic component 124 formed in the previous cycle on the second right general mold cavity part 116, and ejecting a first right product 125 molded in the previous production cycle.

Rotating revolvable section 127 of the right molding block 106 pivoting around the center axis 128 of the injection molding system by a right rotational means, not shown, and combining by the mold positioning system 103 molding blocks 104, 105, 106 so that the first right general mold cavity part 110 is connected with the first right gated mold cavity 111 to form a first right mold cavity 129, and so that the second right general mold cavity part 116 is connected with the second right gated mold cavity part 112 to form a fourth right mold cavity 130, which encompasses the second right plastic component 124.

Figure 7. Injecting by the first injection system 101 via the first runner system 113 first fluid plastic material into the first right mold cavity 129, and solidifying the material to produce a first right plastic component 124a and ap-

proximately at the same time injecting by the second injection system 102 via the second runner system 114 second fluid plastic material into the fourth right mold cavity 130 so that the second fluid plastic is united with the second right plastic component 124 and solidifying the material to mold a second right multicomponent plastic product 125a.

Figure 8. While locking together the right and intermediate molding blocks 106, 105 by the right locking means 118, separating by the mold positioning system 103 the left and intermediate molding blocks 104, 105 and retaining the first left plastic component 122 on the first left general mold cavity part 107, and ejecting the second left product 123.

Rotating revolvable section 126 of the left molding block 104 pivoting around the center axis 128 of the injection molding by the mold positioning system 103 molding blocks 104, 105, 106 so that the first left general mold cavity part 107 is connected with the second left gated mold cavity part 109 to form a second left mold cavity 132 which encompasses the first left plastic component 122, and so that the second left general mold cavity part 115 is connected with the first left gated mold cavity part 108 to form a third left mold cavity 131.

Figure 9. Injecting by the first injection system 101 via the first runner system 113 first fluid plastic material into the third left mold cavity 131, and solidifying the material to produce a second left plastic component 122a and approximately at the same time injecting by the second injection system 102 via the second runner system 114 a second fluid plastic material into the second left mold cavity 132, so that the second fluid plastic is united with the first left plastic component 122 and solidifying the material to mold a first left multicomponent plastic product 123a.

Figure 10. While locking together the left and intermediate molding blocks 104, 105 by the left locking means 117, separating by the mold positioning

system 103 the right and intermediate molding blocks 106, 105 and retaining the first right plastic component 124a on the first right general mold cavity part 110, and ejecting second right product 125a.

Rotating revolvable section 127 of the right molding block 106 pivoting around the center axis 128 of the injection molding system by a right rotational means, not shown, and combining by the mold positioning system 103 molding blocks 104, 105, 106 so that the second right general mold cavity part 116 is connected with the first right gated mold cavity part 111 to form a third right mold cavity 133, and so that the first right general mold cavity part 110 is connected with the second right gated mold cavity part 112 to form a second right mold cavity 134, which encompasses the second right plastic component 124a.

Figure 11. Injecting by the first injection system 101 via the first runner system 103 first fluid plastic material into the third right mold cavity 133, and solidifying the material to produce a second right plastic component 124b and approximately at the same time injecting by the second injection system 102 via the second runner system 114 second fluid plastic material into the second right mold cavity 134 so that the second fluid plastic is united with the first right plastic component 124a and solidifying the material to mold a first right multicomponent plastic product 125b.

Figure 12. While locking together the right and intermediate molding blocks 106, 105 by the right locking means 118, separating by the mold positioning system 103 to the left and intermediate molding blocks 104, 105 and retaining the second left plastic component 122a on the second left general mold cavity part 115, and ejecting the first left product 23a.

Rotating revolvable section 126 of the left molding block 104 pivoting around the center axis 128 of the injection molding system by a left rotational means, not shown, and combining by the mold positioning system 103 molding

blocks 104, 105, 106 to obtain the same mold position as described in the beginning of the production cycle.

While the above description contains many specificities, these should not be construed as limitations on the scope of the invention, but rather a exemplifications of the preferred embodiment thereof. Many other variations are possible.

There may be more than two injection units used and more than three molding blocks, with one more injection unit and one more molding block, three component products may be made. With two more injection units and two more molding blocks, four component products may be made. The molding blocks may be operated in such a fashion that two stack-molds are disposed for axial movement in respect to each other. The injection units may be placed in many different constellations, vertically, horizontally, along the machine axis or perpendicular thereto, or different angles altogether. When using a standard injection molding machine for the method of the invention, the injection units will normally have to be separated from the intermediate molding block at some period of the production cycle, but it is possible to operate the invention with the injection units attached to the intermediate molding block.

If it is necessary to apply hold pressure during a period when an injection unit is detached from the intermediate molding block, it is possible to apply hold pressure to a runner system by constricting the runner system and applying alternative hold pressure by a piston means.

The opening and closing periods may be different from the preferred embodiment, it is for example possible for the left side to open two or three times every time the right side opens once. It is possible to produce a different product in the left side and the right side, as for example a container and a lid both needing two barrier materials for such properties as moisture, oxygen, carbon dioxide, solutions, and air, for products such as foods, carbonated drinks, paints and vacumated blood tubes.

The runner systems may consist of forked or unconnected sections or sections separated by valves of many types. It may be useful to include a controlled valve near or at the gate to each product, although this feature is optional. To start up the system without such valves, either double material is injected the first time or a previously produced product is inserted in half of the mold cavities.

There may be any convenient amount of general mold cavity parts which in turn is exposed to the gated mold cavity parts. If for example there are three general and two gate mold cavity parts, the extra general mold cavity part may be used as a separate station for printing or in line blow molding or the like.

It is also possible to operate the apparatus of the second embodiment of the invention in a synchronous manner. In such case all the mold cavities may be shut or opened synchronously. The apparatus is then operated as follows. The first fluid plastic material is injected into the first left and first right mold cavities simultaneously, then the positioning means are activated simultaneously, then the second fluid plastic material is injected into the second left and second right mold cavities simultaneously, and then the positioning means are activated simultaneously.

CLAIMS

1. A method of cyclic injection molding a first multi-component plastic product and a second multi-component plastic product in an injection molding apparatus comprising a first injection unit, a second injection unit, a right adjustable mold cavity with a first moveable barring means, a left adjustable mold cavity with a second moveable barring means, and a clamping unit, the method comprising the steps of:

(a) protracting the first barring means;

(b) retracting the second barring means;

(c) shutting the clamping unit to thereby apply clamping force simultaneously on the right and left adjustable mold cavity;

(d) injecting a first portion of a first plastic material by the first injection unit into the right adjustable mold cavity, which has its first barring means in the protracted condition, to form a first component of the first multi-component product;

(e) injecting a first portion of a second plastic material by the second injection unit into the left adjustable mold cavity which has its second barring means in the retracted position, to form a second component of the second multi-component product while the left adjustable mold cavity encases a first component of the second multi-component product which has been injected into the left adjustable mold cavity in the previous cycle, whereby the first component of the second multi-component product combines with said injected first portion of the second plastic material to thereby cast said second multi-component product;

(f) opening the clamping unit in order to open the left adjustable mold cavity;

(g) ejecting the second multi-component product;

(h) protracting the second barring means;

(i) retracting the first barring means;

(j) shutting the clamping unit to thereby apply clamping force simultaneously on the right and left adjustable mold cavity;

(k) injecting a second portion of the first plastic material material by the first injection unit into the left adjustable mold cavity, which has its second barring means in the protracted position, to form a first component of the second multi-component product and to encase the first component of the second multi-component product in the left mold cavity for employment in step (e) of the succeeding cycle;

(l) injecting a second portion of the second plastic material by the second injection unit into the right adjustable mold cavity which has its first barring means in the retracted position, to form a second component of said first multi-component product while the right adjustable mold cavity encases the first component of the first multi-component product which has been injected into the right adjustable mold cavity in step (e), whereby the first component of the first multi-component product combines with said injected second portion of the second plastic material to thereby cast said first multi-component product;

(m) opening the clamping unit in order to open the right adjustable mold cavity;

(n) ejecting the first multi-component product.

2. A method according to claim 1, wherein the first multi-component product is essentially identical to the second multi-component product.

3. A method according to claim 1, wherein the injection molding apparatus comprises right, center and left molding blocks for defining the right adjustable mold cavity between right and center molding blocks and the left adjustable mold cavity between the center and left molding blocks, and

wherein step (c) comprises the step of:

(n) moving relatively the right and left molding blocks together;

wherein step (f) comprises the step of:

(o) moving relatively the right and left molding blocks apart;

wherein step (j) comprises the step of:

(p) moving relatively the right and left molding blocks together;

and wherein step (m) comprises the step of:

(q) moving relatively the right and left molding blocks apart.

4. A method according to claim 3, wherein the injection molding apparatus comprises right, center and left molding blocks for defining the right adjustable mold cavity between the right and center molding blocks and the left adjustable mold cavity between the center and left molding blocks, wherein the injection molding apparatus comprises right locking means for locking the right molding block to the center molding block and left locking means for locking the center molding block to the left molding block, and

wherein the method subsequent to step (c) comprises the step of:

(n) locking the right and center molding blocks together;

wherein the method prior to step (f) comprises the step of:

(o) unlocking the center and left molding blocks;

wherein the method subsequent to step (j) comprises the step of:

(p) locking the center and left molding blocks together; and

wherein the method prior to step (m) comprises the step of:

(q) unlocking the right and center molding blocks.

5. A method according to claim 1, wherein step (d) and step (e) takes place at approximately the same time and wherein step (k) and step (1) takes place at approximately the same time.

6. A method according to claim 1, wherein step (a) and step (b) takes place at approximately the same time and wherein step (h) and step (i) takes place at approximately the same time.

7. A method according to claim 1, wherein step (a) and step (b) takes place in the period after the beginning of step (m) of the previous molding cycle and before the termination step (c) and wherein step (h) and step (i) takes place in the period after the beginning of step (f) and before the termination of step (j).

8. A method of cyclic injection molding a first multi-component plastic product and a second multi-component plastic product in an injection molding apparatus comprising a first injection unit, a second injection unit, a common clamping unit, right, center and left molding blocks for defining a right adjustable mold

cavity between the right and center molding blocks and a left adjustable mold cavity between the center and left molding blocks, a first left runner system for leading plastic molding material from the first injection unit to the left adjustable mold cavity, a first right runner system for leading plastic molding material from the first injection unit to the right adjustable mold cavity, a second left runner system for leading plastic molding material from the second injection unit to the left adjustable mold cavity, a second right runner system for leading plastic molding material from the second injection unit to the right adjustable mold cavity, the method comprising the steps of:

(a) adjusting the right mold cavity;

(b) adjusting the left mold cavity;

(c) shutting the common clamping unit to thereby apply clamping force with the common clamping unit on the right and left adjustable mold cavity;

(d) injecting a first portion of a first plastic material by the first injection unit into the right adjustable mold cavity, via the first right runner system, to form a first component of the first multi-component product;

(e) injecting a first portion of a second plastic material by the second injection unit into the left adjustable mold cavity, via the second left runner system, to form a second component of the second multi-component product while the left adjustable mold cavity encases a first component of the second multi-component product which has been injected into the left adjustable mold cavity in the previous cycle, whereby the first component of the second multi-component product combines with said injected first portion of the second plastic material to thereby cast said second multi-component product;

(f) opening the common clamping unit in order to open the left adjustable mold cavity;

(g) ejecting the second multi-component product;

(h) adjusting the left mold cavity;

(i) adjusting the right mold cavity;

(j) shutting the common clamping unit to thereby apply clamping force with the common clamping unit on the left and right adjustable mold cavity;

(k) injecting a second portion of the first plastic material by the first injection unit into the left adjustable mold cavity, via the first left runner system, to form a first component of the second multi-component product and to encase the first component of the second multi-component product in the left mold cavity for employment in step (e) of the succeeding cycle;

(l) injecting a second portion of the second plastic material by the second injection unit into the right adjustable mold cavity, via the second right runner system, to form a second component of said first multi-component product while the right adjustable mold cavity encases the first component of the first multi-component product which has been injected into the right adjustable mold cavity in step (e), whereby the first component of the first multi-component product combines with said injected second portion of the second plastic material to thereby cast said first multi-component product;

(m) opening the common clamping unit in order to open the right adjustable mold cavity;

(n) ejecting the first multi-component product.

9. A method according the claim 8, wherein step (a) and step (b) takes place in the period after the beginning of step (m) of the previous molding cycle and before the termination step (c) and wherein step (h) and step (i) takes place in the period after the beginning of step (f) and before the termination of step (j).

10. A method according to claim 8, wherein the injection molding apparatus comprises right locking means for locking the right molding block to the center molding block and left locking means for locking the center molding block to the left molding block, and

wherein step (c) comprises the step of:

(n) locking the right and center molding blocks together;

wherein step (f) comprises the step of:

(o) unlocking the center and left molding blocks;

wherein step (j) comprises the step of:

(p) locking the center and left molding blocks together; and

wherein step (m) comprises the step of:

(q) unlocking the right and center molding blocks.

11. An apparatus for cyclic injection molding a first multi-component plastic product and a second multi-component plastic product comprising

a first injection unit, a second injection unit, a right adjustable mold cavity with a first moveable barring means, a left adjustable mold cavity with a second moveable barring means, right, center and left molding blocks, so that the right and adjustable mold cavity is defined between the right and center molding blocks, and the left adjustable mold cavity is defined between the center and left molding blocks, and

means for protracting the first barring means;

means for retracting the second barring means;

means for shutting the clamping unit to thereby apply clamping force simultaneously on the right and left adjustable mold cavity;

means for injecting a first portion of a first plastic material by the first injection unit into the right adjustable mold cavity, when the right adjustable mold cavity has its first barring means in the protracted condition;

means for injecting a first portion of a second plastic material by the second injection unit into the left adjustable mold cavity when the second injection unit has its second barring means in the retracted position;

means for opening the clamping unit in order to open the left adjustable mold cavity;

means for ejecting the second multi-component product;

means for protracting the second barring means;

means for retracting the first barring means;

means for injecting a second portion of the first plastic material by the first injection unit into the left adjustable mold cavity, when the first injection unit has its second barring means in the protracted position;

means for injecting a second portion of the second plastic material by the second injection unit into the right adjustable mold cavity when the right adjustable mold cavity has its barring means in the retracted position;

means for opening the clamping unit in order to open the right adjustable mold cavity;

means for ejecting the first multi-component product.

12. An apparatus according to Claim 11, comprising right, center and left molding blocks for defining the right adjustable mold cavity between the right and center molding blocks and the left adjustable mold cavity between the center and left molding blocks, and

means for moving relatively the right and left molding blocks together;

means for moving relatively the right and left molding blocks apart.

13. An apparatus according to claim 11, wherein the injection molding apparatus comprises right, center and left molding blocks for defining the right adjustable mold cavity between the right and center molding blocks and the left adjustable mold cavity between the center and left molding blocks, wherein the injection molding apparatus comprises right locking means for locking and unlocking the right molding block to the center molding block and left locking means for locking and unlocking the center molding block to the left molding block.

14. An apparatus for cyclic injection molding a first multi-component plastic product and a second multi-component plastic product comprising a first injection unit, a second injection unit, a common clamping unit, right, center and left molding blocks for defining a right adjustable mold cavity between the right and center molding blocks and a left adjustable mold cavity between the center and left molding blocks, the center block comprising a first left runner system for leading plastic molding material from the first injection unit to the left adjustable mold cavity, a first right runner system for leading plastic molding material from the first injection unit to the right adjustable mold cavity, a second left runner system for leading plastic molding material from the second injection unit to the left adjustable mold cavity, a second right runner system for leading plastic molding material from the second injection unit to the right adjustable mold cavity, and

means for adjusting the right mold cavity;

means for adjusting the left mold cavity;

means for shutting the common clamping unit in order to apply clamping force with the common clamping unit on the right and left adjustable mold cavity;

means for injecting a first portion of a first plastic material by the first injection unit into the right adjustable mold cavity, via the first right runner system;

means for injecting a first portion of a second plastic material by the second injection unit into the left adjustable mold cavity, via the second left runner system;

means for opening the common clamping unit in order to open the left adjustable mold cavity;

means for ejecting the second multi-component product;

means for readjusting the left mold cavity;

means for readjusting the right mold cavity;

means for injecting a second portion of the first plastic material by the first injection unit into the left adjustable mold cavity, via the first left runner system;

means for injecting a second portion of the second plastic material by the second injection unit into the right adjustable mold cavity, via the second right runner system;

means for opening the common clamping unit in order to open the right adjustable mold cavity;

means for ejecting the first multi-component product.

15. An apparatus according to claim 14, wherein the injection molding apparatus comprises right locking means for locking and unlocking the right molding block to the center molding block and left locking means for locking and unlocking the center molding block to the left molding block.

16. A method of cyclic injection molding a first multi-component plastic product and a second multi-component plastic product in an injection molding apparatus comprising an injection unit, a right adjustable mold cavity with a first moveable barring means, a left adjustable mold cavity with a second moveable barring means, and a clamping unit, the method comprising the steps of:

(a) protracting the first barring means;

(b) retracting the second barring means;

(c) shutting the clamping unit to thereby apply clamping force simultaneously on the right and left adjustable mold cavity;

(d) injecting a first portion of a first plastic material by the injection unit into the right adjustable mold cavity, which has its first barring means in the protracted condition, to form a first component of the first multi-component product;

(e) injecting a first portion of a second plastic material by the injection unit into the left adjustable mold cavity which has its second barring means in the retracted position, to form a second component of said second multi-component product while the left adjustable mold cavity encases a first component of the second multi-component product which has been injected into the left adjustable mold cavity in the previous cycle, whereby the first component of the second

multi-component product combines with said injected first portion of the second plastic material to thereby cast said second multi-component product;

(f) opening the clamping unit in order to open the left adjustable mold cavity;

(g) ejecting the second multi-component product;

(h) protracting the second barring means;

(i) retracting the first barring means;

(j) shutting the clamping unit to thereby apply clamping force simultaneously on the right and left adjustable mold cavity;

(k) injecting a second portion of the first plastic material by the injection unit into the left adjustable mold cavity, which has its second barring means in the protracted position, to form a first component of the second multi-component product and to encase the first component of the second multi-component product in the left mold cavity for employment in step (e) of the succeeding cycle;

(l) injecting a second portion of the second plastic material by the injection unit into the right adjustable mold cavity which has its first barring means in the retracted position, to form a second component of said first multi-component product while the right adjustable mold cavity encases the first component of the first multi-component product which has been injected into the right adjustable mold cavity in step (e), whereby the first component of the first multi-component product combines with said injected second portion of the second plastic material to thereby cast said first multi-component product;

(m) opening the common clamping unit in order to open the right adjustable mold cavity;

(n) ejecting the first multi-component product.

17. A method of cyclic injection molding a first multi-component plastic product and a second multi-component plastic product in an injection molding apparatus comprising an injection unit, a common clamping unit, right, center and left molding blocks for defining a right adjustable mold cavity between the right and center molding blocks and a left adjustable mold cavity between the center and left molding blocks, a runner system for leading plastic molding material from the injection unit to the left adjustable mold cavity, a right runner system for leading plastic molding material from the injection unit to the right adjustable mold cavity, the method comprising the steps of:

(a) adjusting the right mold cavity;

(b) adjusting the left mold cavity;

(c) shutting the common clamping unit to thereby apply clamping force with the common clamping unit on the right and left adjustable mold cavity;

(d) injecting a first portion of a first plastic material by the

injection unit into the right adjustable mold cavity, via the first right runner system, to form a first component of the first multi-component product;

(e) injecting a first portion of a second plastic material by the

injection unit into the left adjustable mold cavity, via the second left runner system, to form a second component of the second multi-component product while the left adjustable mold cavity encases a first component of the second multi-component product which has been injected into the left adjustable mold cavity in the previous cycle, whereby the first component of the second multi-component product combines with said injected first portion of the second plastic material to thereby cast said second multi-component product;

(f) opening the common clamping unit in order to open the left adjustable mold cavity;

(g) ejecting the second multi-component product;

(h) adjusting the left mold cavity;

(i) adjusting the right mold cavity;

(j) shutting the common clamping unit to thereby apply clamping force with the common clamping unit on the left and right adjustable mold cavity;

(k) injecting a second portion of the first plastic material by the first injection unit into the left adjustable mold cavity, via the first left runner system, to form a first component of the second multi-component product and to encase the first component of the second multi-component product in the left mold cavity for employment in step (e) of the succeeding cycle;

(l) injecting a second portion of the second plastic material by the

injection unit into the right adjustable mold cavity, via the second right runner system, to form a second component of said first multi-component product while the right adjustable mold cavity encases the first component of the first multi-component product which has been injected into the right adjustable mold cavity in step (e), whereby the first component of the first multi-component product combines with said injected second portion of the second plastic material to thereby cast said first multi-component product;

(m) opening the common clamping unit in order to open the right adjustable mold cavity;

(n) ejecting the first multi-component product.

18. An apparatus for cyclic injection molding a first multi-component plastic product and a second multi-component plastic product comprising an injection unit, a right adjustable mold cavity with a first moveable barring means, a left adjustable mold cavity with a second moveable barring means, and

means for protracting the first barring means;

means for retracting the second barring means;

means for shutting the clamping unit to thereby apply clamping force simultaneously on the right and left adjustable mold cavity;

means for injecting a first portion of a first plastic material by the injection unit into the right adjustable mold cavity, when the right adjustable mold cavity has its first barring means in the protracted condition;

means for injecting a first portion of the second plastic material by the injection unit into the left adjustable mold cavity when the second injection unit has its second barring means in the retracted position;

means for opening the clamping unit in order to open the left adjustable mold cavity;

means for ejecting the first multi-component product;

means for protracting the second barring means;

means for retracting the first barring means;

means for injecting a second portion of the first plastic material by the injection unit into the left adjustable mold cavity, when the first injection unit has its second barring means in the protracted position;

means for injecting a second portion of the second plastic material by the injection unit into the right adjustable mold cavity when the right adjustable mold cavity has its first barring means in the retracted position;

means for opening the clamping unit in order to open the right adjustable mold cavity;

means for ejecting the first multi-component product.

19. An apparatus for cyclic injection molding a first multi-component plastic product and a second multi-component plastic product comprising a injection unit, a common clamping unit, right, center and left molding blocks for defining a right adjustable mold cavity between the right and center molding blocks and a left adjustable mold cavity between the center and left molding blocks, the center block comprising a left runner system for leading plastic molding material from the injection unit to the left adjustable mold cavity, a right runner system for leading plastic molding material from the injection unit to the right adjustable mold cavity, and

means for adjusting the right mold cavity;

means for adjusting the left mold cavity;

means for shutting the common clamping unit in order to apply clamping force with the common clamping unit on the right and left adjustable mold cavity;

means for injecting a first portion of a first plastic material by the injection unit into the right adjustable mold cavity, via the first right runner system;

means for injecting a first portion of a second plastic material by the injection unit into the left adjustable mold cavity, via the second left runner system;

means for opening the common clamping unit in order to open the left adjustable mold cavity;

means for ejecting the second multi-component product;

means for readjusting the left mold cavity;

means for readjusting the right mold cavity;

means for injecting a second portion of the first plastic material by the injection unit into the left adjustable mold cavity, via the first left runner system;

means for injecting a second portion of the second plastic material by the injection unit into the right adjustable mold cavity, via the second right runner system;

means for opening the common clamping unit in order to open the right adjustable mold cavity;

means for ejecting the first multi-component product.

20. A method of cyclic injection molding a multicomponent product in an injection molding system comprising a mold positioning system, a first injection system and a second injection system, and a left molding block, a right molding block and an intermediate molding block located between the left and the right molding blocks, said blocks being disposed for movement in respect to each other,

the left molding block defining a first left general mold cavity part and the intermediate molding block defining a first left gated mold cavity part and a second left gated mold cavity part,

the right molding block defining a first right general mold cavity part and the intermediate molding block defining a first right gated mold cavity part and a second right gated mold cavity part,

the intermediate molding block defining a first runner system and a second runner system connected to said gated mold parts, the method comprising the steps of

(a) combining by the mold positioning system said molding blocks so that the first left general mold cavity part is connected with the first left gated mold cavity part to form a first left mold cavity,

(b) injecting by the first injection system via the first runner system a first fluid plastic material into the first left mold cavity, and solidifying the material to produce a first left plastic component,

(c) separating by the mold positioning system the right and center molding blocks,

(d) combining by the mold positioning system said molding blocks so that the first right general mold cavity part is connected with the first right gated mold cavity part to form a first right mold cavity,

(e) injecting by the first injection system via the first runner system first fluid plastic material into the first right mold cavity, and solidifying the material to produce a first right plastic component,

(f) separating by the mold positioning system the left and center molding blocks, retaining the first left plastic component on the first left general mold cavity part,

(g) combining by the mold positioning system said molding blocks so that the first left general mold cavity part is connected with the second left gated mold cavity part to form a second left mold cavity, which encompasses said first left plastic component,

(h) injecting by the second injection system via the second runner system a second fluid plastic material into the second left mold cavity so that the second fluid plastic is united with the first left plastic component and solidifying the material to mold a first left multicomponent plastic product,

(i) separating by the mold positioning system the right and center molding blocks, retaining the first right plastic component on the first right general mold cavity part,

(j) combining by the mold positioning system said molding blocks so that the first right general mold cavity part is connected with the second right gated mold cavity part to form a second right mold cavity, which encompasses said first right plastic component,

(k) injecting by the second injection system via the second runner system second fluid plastic material into the second right mold cavity so that the second fluid plastic is united with the first right plastic component and solidifying the material to mold a first right multicomponent plastic product,

(l) separating by the mold positioning system the left and center molding blocks, to eject the first left product molded in step (h),

wherein step (c) comprises the step of

(m) ejecting a first right product molded in step (k) of the preceding molding cycle.

21. A method according to claim 20 wherein the left molding block defines at least one second left general mold cavity part and the right molding block defines at least one second right general mold cavity part, and comprising the steps of

wherein step (g) comprises the step of

(n) combining by the mold positioning system said molding blocks so that one of said at least one second left general mold cavity part is connected with the first left gated mold cavity part to form a third left mold cavity,

wherein step (h) comprises the step of

(o) injecting by the first injection system via the first runner system first fluid plastic material into the third left mold cavity, and solidifying the material to produce a second left plastic component,

wherein step (i) comprises the step of

(p) separating by the mold positioning system the right and center molding blocks,

wherein step (j) comprises the step of

(q) combining by the mold positioning system said molding blocks so that one of said at least one second right general mold cavity part is connected with the first right gated mold cavity part to form a third right mold cavity,

wherein step (k) comprises the step of

(r) injecting by the first injection system via the first runner system first fluid plastic material into said third right mold cavity, and solidifying the material to produce a second right plastic component,

wherein step (l) comprises the step of

(s) separating by the mold positioning system the left and center molding blocks, retaining the second left plastic component on one of said at least one second left general mold cavity part.

wherein step (a) of the following cycle comprises the step of

(t) combining by the mold positioning system said molding blocks so that any one of said at least one left general mold cavity part is connected with the second left gated mold cavity part to form a fourth left mold cavity, which encompasses said second left plastic component,

wherein step (b) of the following cycle comprises the step of

(u) injecting by the second injection system via the second runner system second fluid plastic material into the fourth left mold cavity so that the second fluid plastic is united with the second left plastic component and solidifying the material to mold a second left multicomponent plastic product,

wherein step (c) of the following cycle comprises the step of

(v) separating by the mold positioning system the right and center molding blocks, retaining the second right plastic component on any one of said at least one right general mold cavity part,

wherein step (d) of the following cycle comprises the step of

(w) combining by the mold positioning system said molding blocks so that any one of said at least one right general mold cavity part is connected with the second right gated mold cavity part to form a fourth right mold cavity, which encompasses said second right plastic component,

wherein step (e) of the following cycle comprises the step of

(x) injecting by the second injection system via the second runner system second fluid plastic material into the fourth right mold cavity so that the second fluid plastic is united with the second right plastic component and solidifying the material to mold a second right multicomponent plastic product,

wherein step (f) of the following cycle comprises the step of

(y) separating by the mold positioning system the left and center molding blocks, to eject the second left product molded in step (u),

wherein step (p) comprises the step of

(z) ejecting a second right product molded in step (e).

22. A method according to claim 21, wherein the method utilizes only one second left general mold cavity part and the method utilizes only one second right general mold cavity part.

23. An injection molding apparatus for cyclic injection molding a multicomponent product comprising a mold positioning system, a first injection system and a second injection system, and a left molding block, a right molding block and an intermediate molding block located between the left and the right molding blocks, said blocks being disposed for axial movement in respect to each other, the left molding block defining a first left general mold cavity part and the intermediate molding block defining a first left gated mold cavity part and a second left gated mold cavity part, the right molding block defining a first right general mold cavity part and the intermediate molding block defining a first right gated mold cavity part and a second right gated mold cavity part, the injection molding apparatus comprising:

a mold positioning system for combining said molding blocks so that the first left general mold cavity part is connected with the first left gated mold cavity part to form a first left mold cavity,

the first injection system comprising means for injecting a first fluid plastic material into the first left mold cavity, to produce a left plastic component,

the mold positioning system comprising means for separating the right and center molding blocks,

means for ejecting a right multicomponent plastic product,

the mold positioning system comprising means for combining said molding blocks so that the first right general mold cavity part is connected with the first right gated mold cavity part to form a first right mold cavity,

the first injection system comprising means for injecting first fluid plastic material into the first right mold cavity to produce a right plastic component,

the mold positioning system comprising means for separating the left and center molding blocks,

means for retaining said left plastic component on the first left general mold cavity part,

the mold positioning system comprising means for combining said molding blocks so that the first left general mold cavity part is connected with the second left gated mold cavity part to form a second left mold cavity, so that the second left mold cavity may encompass said left plastic component,

the second injection system comprising means for injecting second fluid plastic material into the second left mold cavity so that the second fluid plastic may be united with said left plastic component, to mold a left multicomponent plastic product,

means for retaining said right plastic component on the first right general mold cavity part, when the mold positioning system separates the right and center molding blocks,

the mold positioning system comprising means for combining said molding blocks so that the first right general mold cavity part is connected with the second right gated mold cavity part to form a second right mold cavity, so that the second right mold cavity may encompass said right plastic component,

the second injection system comprising means for injecting second fluid plastic material into the second right mold cavity so that the second fluid plastic

46 may be united with said right plastic component to mold a right multicomponent plastic product,

48 means for ejecting the left multicomponent plastic product, when the mold positioning system separates the left and center molding blocks.

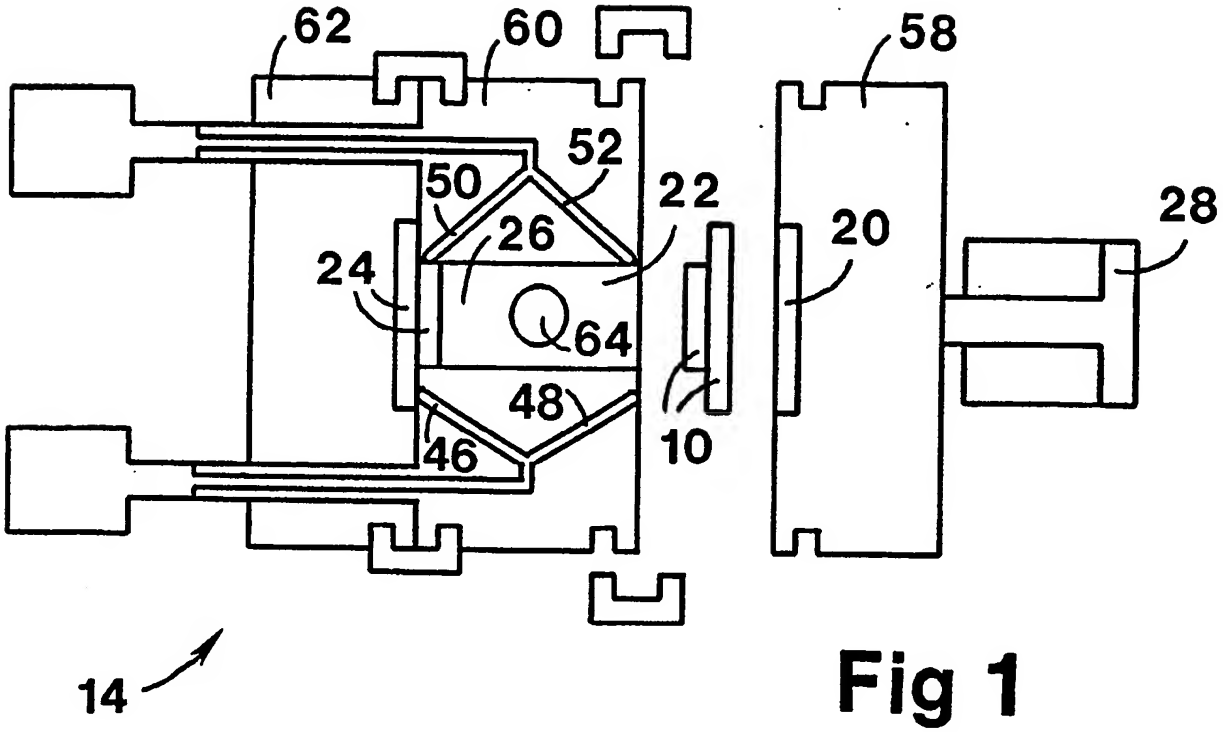
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Fig 1

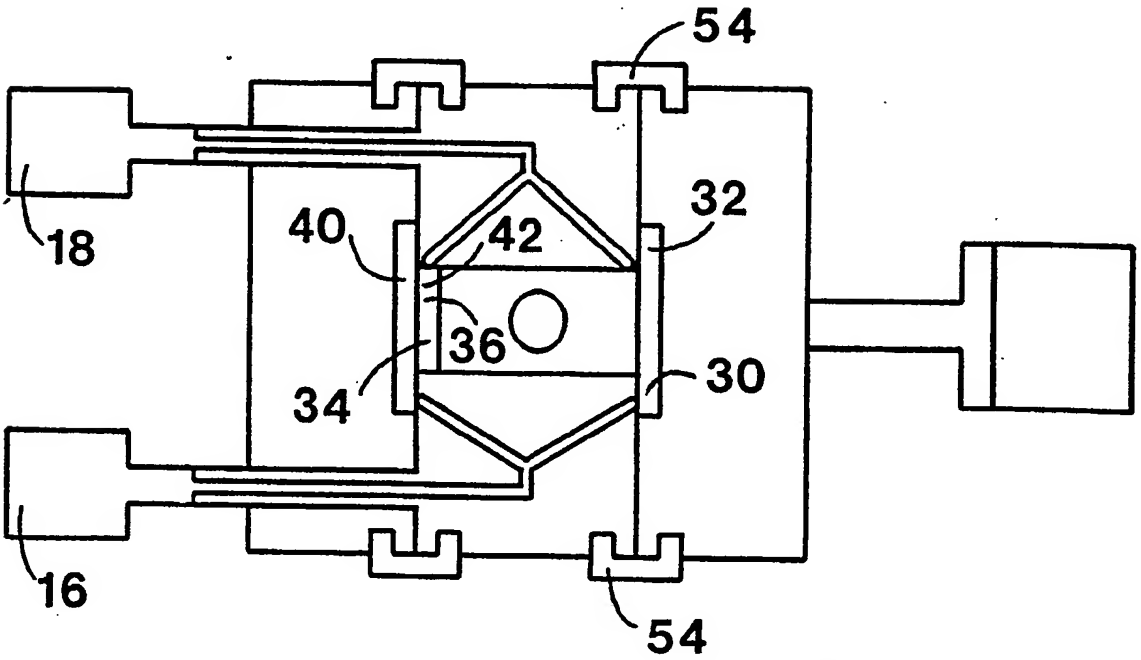
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Fig 2

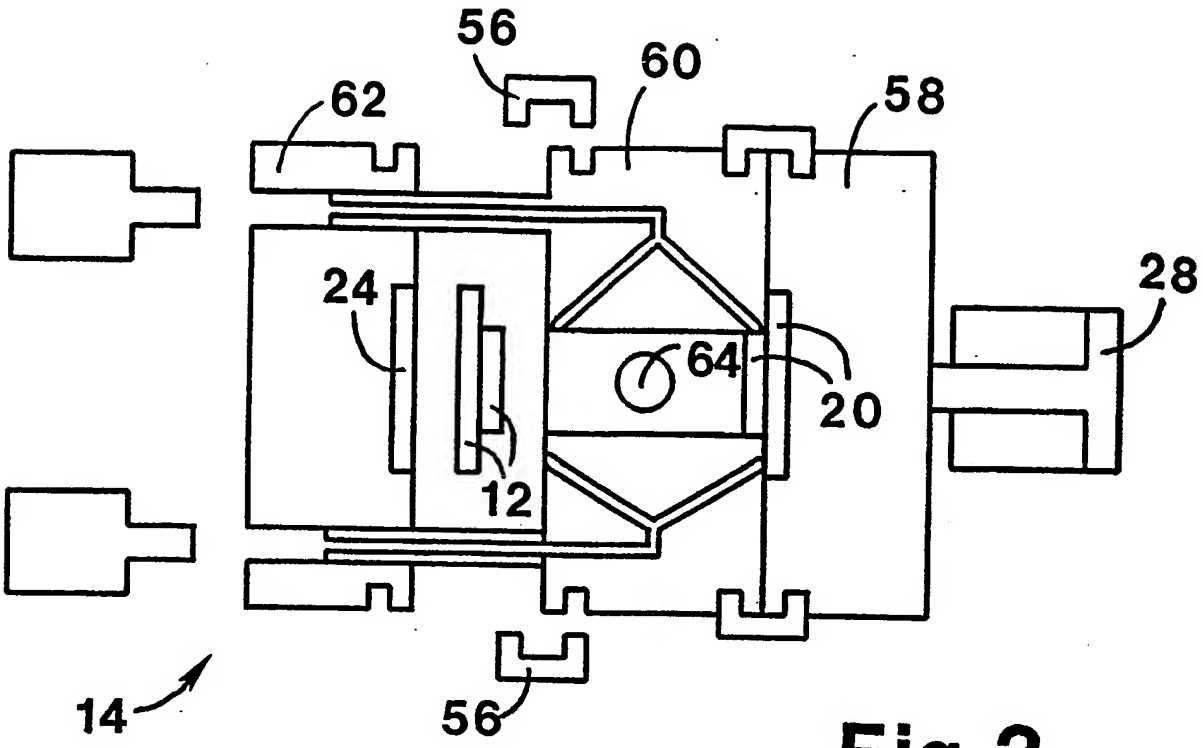

Fig 3

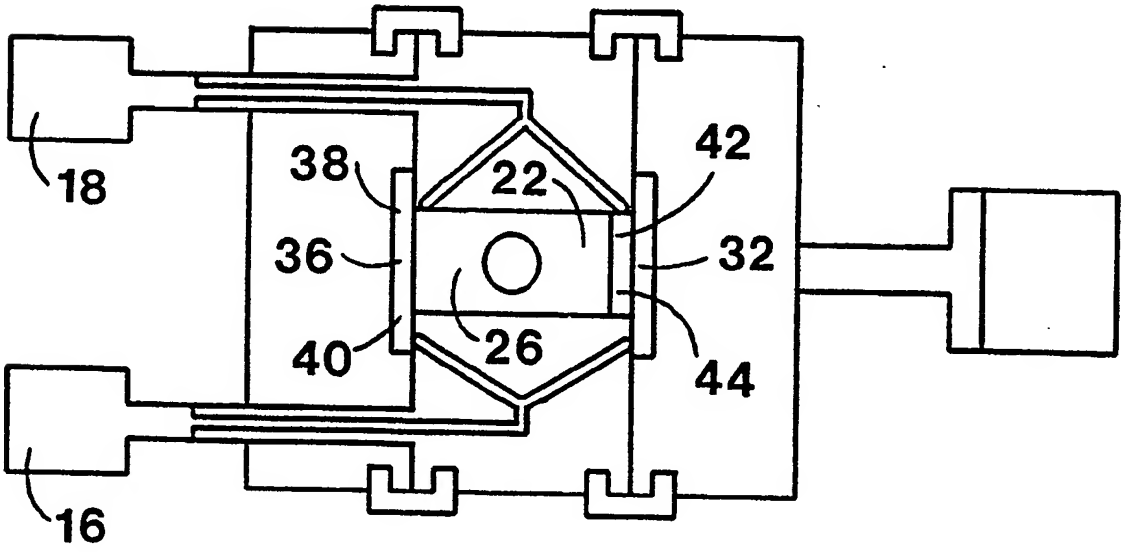

Fig 4

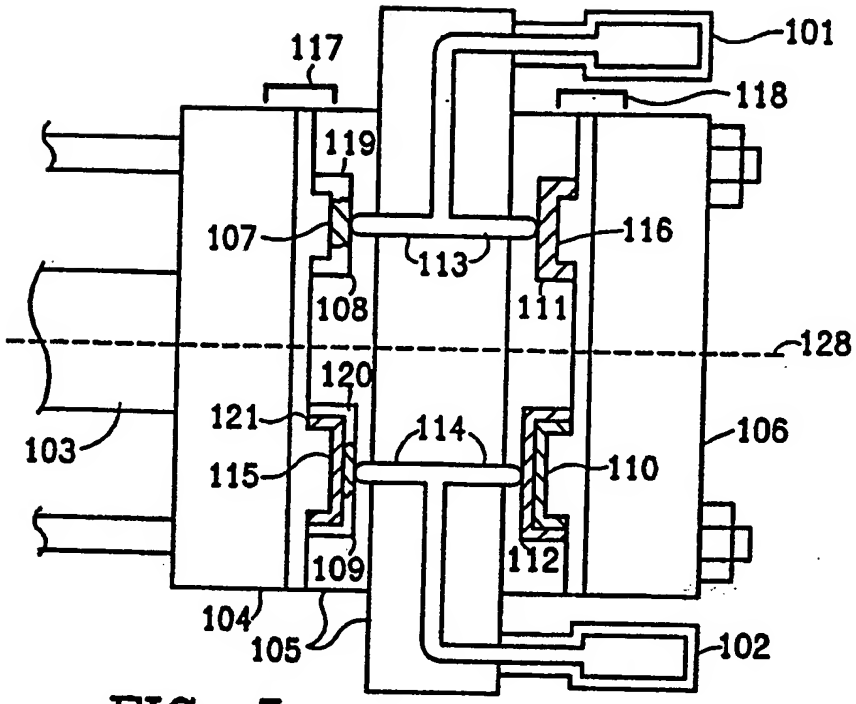
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FIG. 5

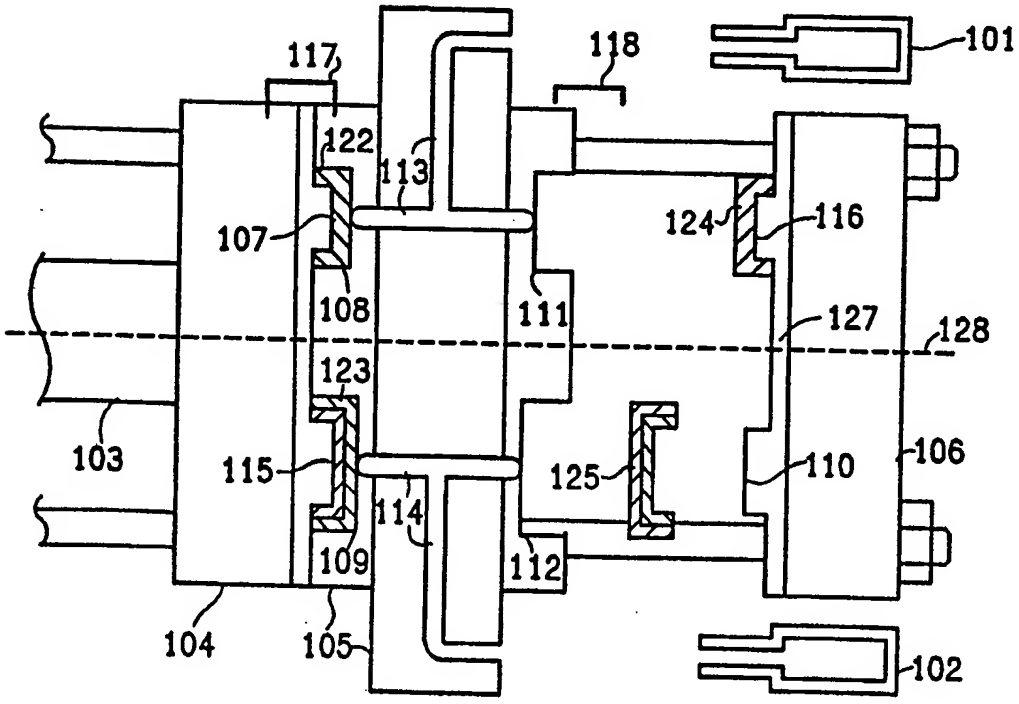
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FIG. 6

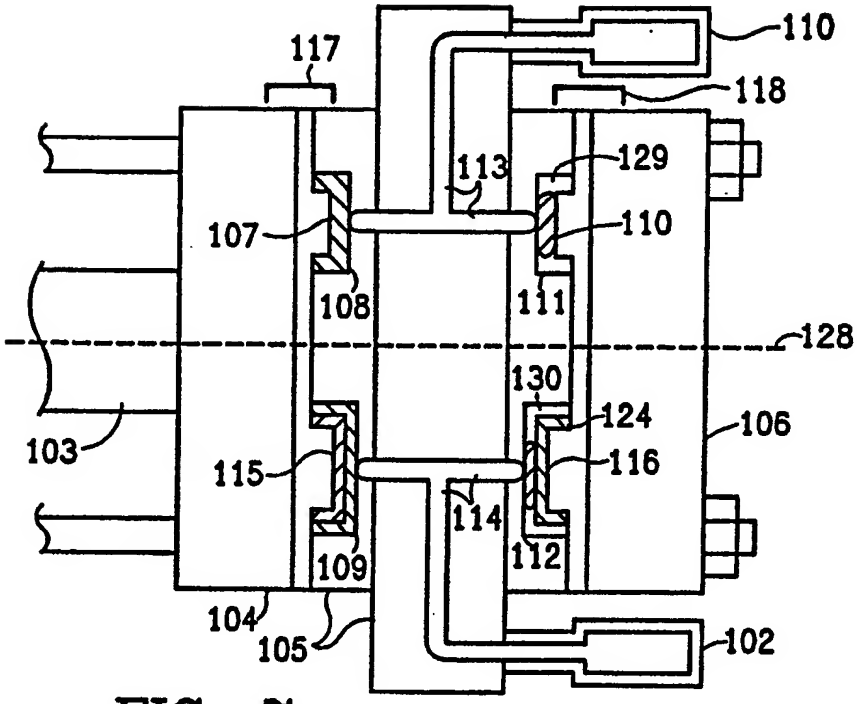
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FIG. 7

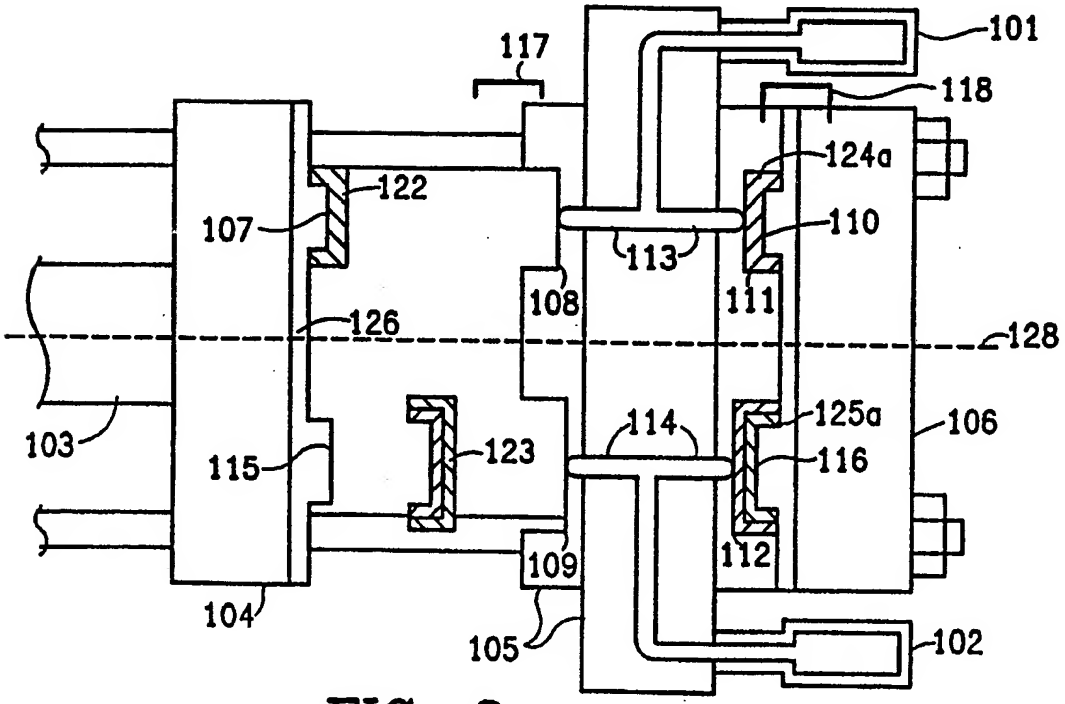
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FIG. 8

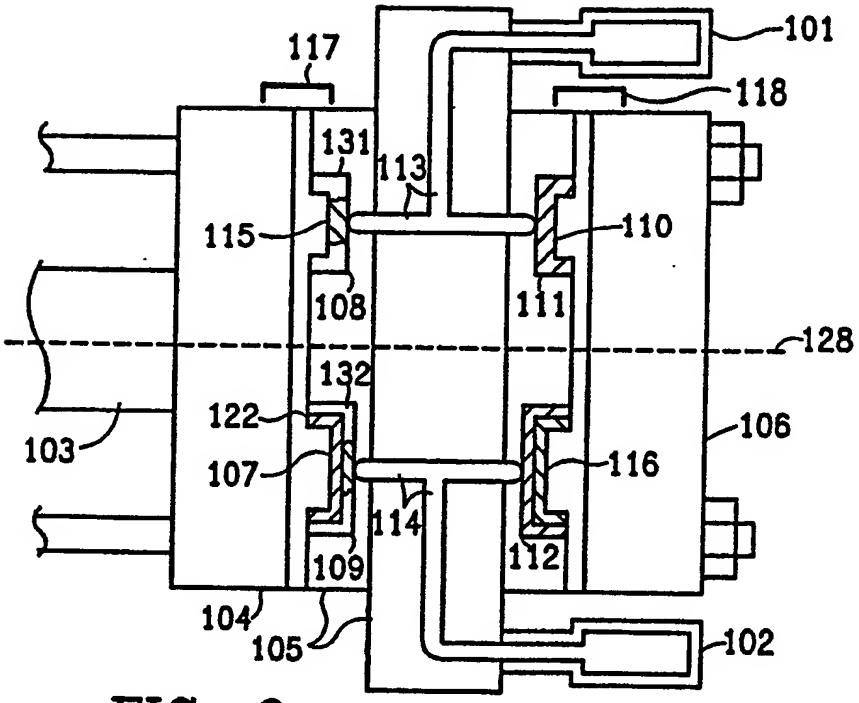
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FIG. 9

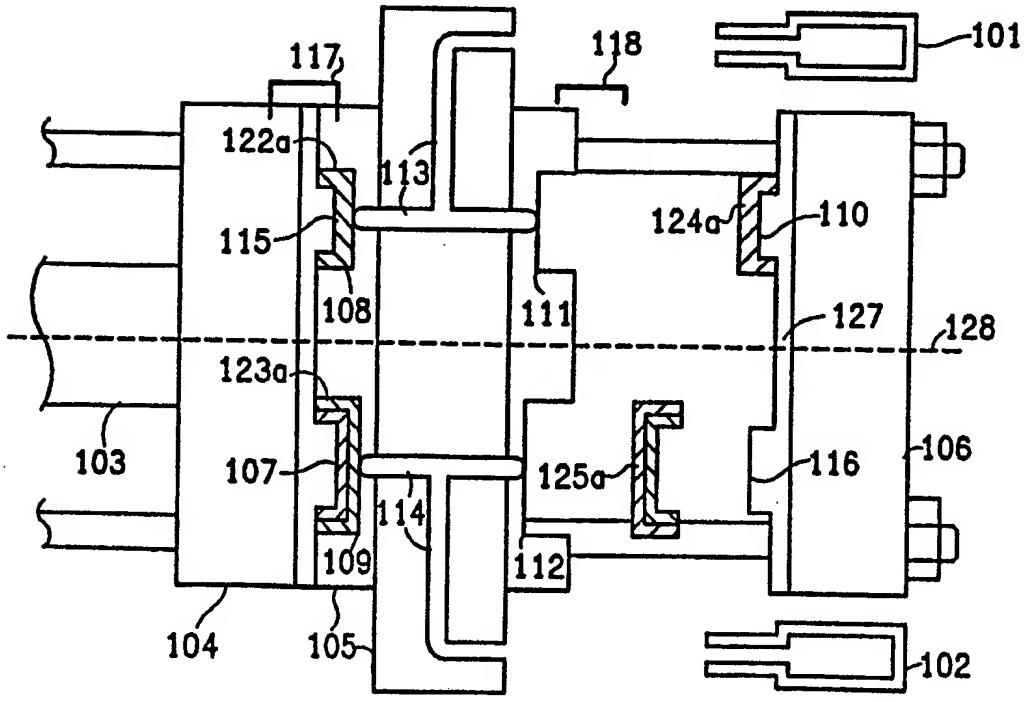
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FIG. 10

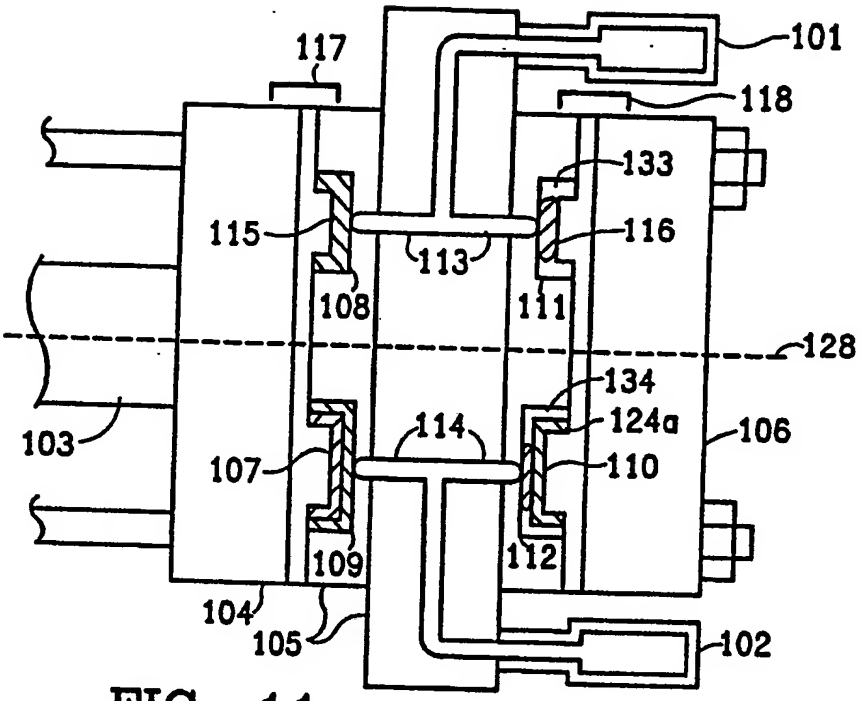
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FIG. 11

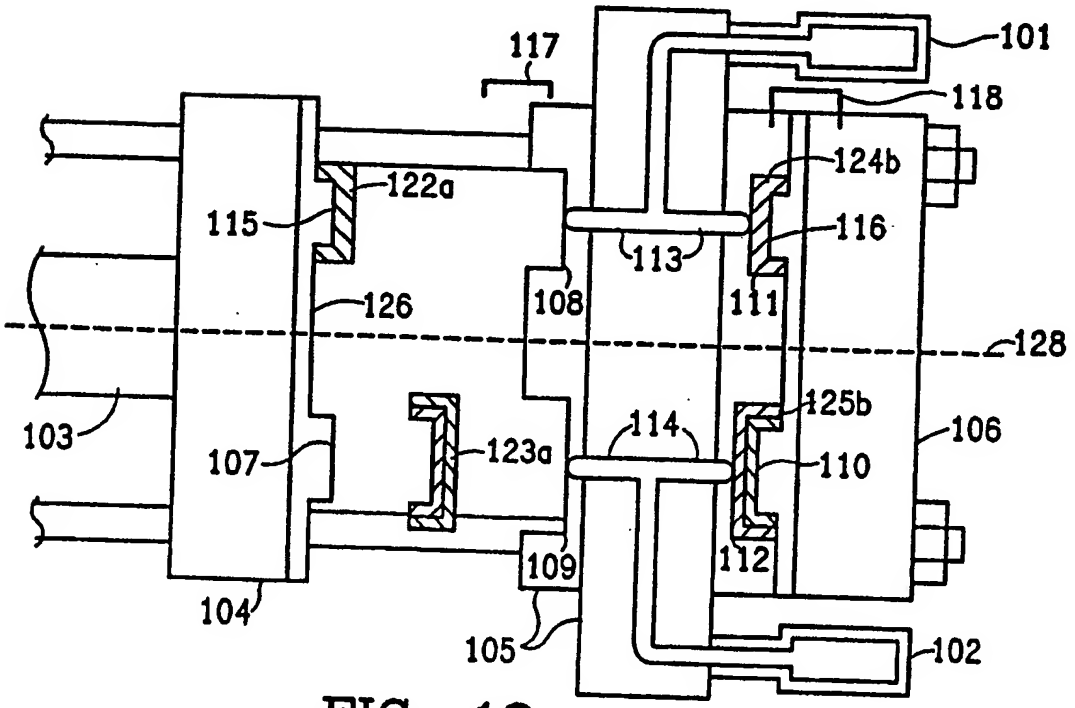
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FIG. 12

INTERNATIONAL SEARCH REPORT

International Application No PCT/US90/04566

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5):: B29C 45/16

US CL.: 264/255, 328.7, 328.8, 425/129.1, 588

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
US	264/245,255,297.2,297.8,328.7,328.8,328.11,297.2 425/120,129.1,130,572,577,588,134

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	US, A, 4,416,602 NEUMEISTER 22 November 1983 See the entire document.	1,2,6,7,11,16, 18
A	US, A, 4,726,758 SEKINE 23 FEBRUARY 1988 See figures 4 and 5.	1-19
A	GB, A, 1,061,234 HEHL 08 MARCH 1967 See figure 1a.	1-19
A,P	US, A, 4,935,184 SORENSEN 19 JUNE 1990 See figures 3A-3D.	20-23
A	JP, A, 59-73930 MITSUBISHI 26 APRIL 1984 See abstract.	20-23

* Special categories of cited documents: [15]

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
30 OCTOBER 1990	07 JAN 1991
International Searching Authority [1]	**Signature of Authorized Officer**
ISA/US	NGUYEN NGOC-HO INTERNATIONAL DIVISION For JILL L. HEITBRINK Ngoc-Ho Nguyen

Form PCT/ISA/210 (second sheet) (May 1986)